

genitalia with 2 lateral, curved, chitinous hooks, pointing anteriorly. Dorsal carina running the whole length of the body, becoming more distinct toward the end of the abdomen. Antennae lying ventrally, overlapping the elytra. Head bent ventrally at right angles to prothorax. First pair of legs lying between other pairs.

EXPLANATION OF PLATE I

CUPES CONCOLOR WESTW.

Fig. 1. *Larva* (23.5 mm.). (a) ventral view, (b) lateral, (c) dorsal, (d) mouth parts, ventral view, (e) anal segment, ventral view.

Fig. 2. *Pupa* (11.5 mm.). Note last two joints of the left antennae of pupa figured are deformed. (a) lateral view, (b) ventral view.

Fig. 3. *Adult*

Photographs by H. S. Barber. Drawings by C. T. Greene.

OBSERVATIONS ON THE LIFE HISTORY OF MICROMALTHUS DEBILIS LEC.

(Coleoptera.)

BY HERBERT S. BARBER,

(Bureau of Entomology.)

In February, 1911, Mr. T. E. Snyder of the Bureau of Entomology, brought me for determination, some minute larvæ he had found in the buried end of a chestnut telegraph pole in this city. They were utterly strange to me but by chance the almost forgotten plate (here reproduced) of *Micromalthus* by the late Mr. H. G. Hubbard,¹ the first figures published by him, came to mind and the details there shown agreed so exactly with the fresh larvæ, that the determination was considered positive.

The history of our knowledge of this beetle is interesting. In August 1874, Messrs. Hubbard and Schwarz found a colony of larvæ, pupæ and teneral imagoes in a red-rotten oak log near Detroit, Michigan. They sent specimens to Dr. LeConte, whose description of the new genus and species, placed tentatively in the Lymexylidæ, appeared in their "Coleoptera of Michigan"² with Hubbard's description and plate of figures appended at LeConte's request. Its assignment to the Lymexylidæ was decided upon after correspondence between LeConte and Hubbard, the latter having found some points of similarity in the larvæ of *Hylocatus*.

¹ Proc. Amer. Philos. Soc., xvii, 1878, pp. 666-668 pl. xv.

² l. c., p. 613.

I do not know of another published reference to the beetle, except the checklist inclusion of the name, and Blatchley's¹ reference to the original capture by Hubbard and Schwarz.

In August of about 1882 or 1883, a flying adult lit on Mr. Schwarz's newspaper while he was reading in front of Professor Riley's house (on R st., near 13th, this city), and was immediately saved for the collection. Twenty years later (August 9, 1902) one alighted on my shirt while I was riding with Mr. Schwarz one warm afternoon on the Cabin John Car, just outside the District. This remained unique in my experience for nine years, until Mr. Snyder's larvæ were identified. Mr. Charles Dury writes that on August 9, 1911, one lit on his paper at dusk in Cincinnati, Ohio, this being his only experience with the species.

Mr. Snyder has found the larvæ occasionally since, and has kindly furnished the following locality and host-plant records. The first colony found extended 2 or 3 feet below the brick sidewalk in the base of a chestnut telegraph pole (on 9th Street near "P" Street N. W. Washington, D. C., February 3, 1911), the larvæ making shallow longitudinal burrows filled with fine, boring dust in the porous layer between the harder layers of annual growth. These burrows occurred only in the moist outer layers of the wood which had reached the red stage of decay. A second colony was found at East Falls Church, Virginia, March 18, 1912, in the moist outer layers of a decaying chestnut log and, in the jar of this material kept for rearing, a winged adult was found alive on July 20, 1912. Another colony was found near the same locality, on June 4, 1912, living in a chestnut stump; and a yellow pine log at Natural Bridge, Kentucky, (September 6, 1912) contained a very numerous colony of larvæ in the rotting, softer parts between the more resinous annual rings.²

¹ Coleopt. of Indiana, 1910, p. 895.

² Subsequent to the presentation of this paper, the breeding cell of this material dislosed on February 8, 1913, a few little, legged larvæ and when the rotten wood was broken up it was found that the colony was apparently just coming to maturity. Several specimens of the reproductive form were isolated, one of which began giving birth to young almost immediately (tail first and active, but becoming quiescent for a time afterward). Another, much shrunken, was with her nine young in her cell. Another cell contained twenty-one young but the mother could not be found. Two others of the reproductive form show the mandibles and anal armature of the unborn embryos through the dorsal integument,—fourteen in one, eight in the other. A number of mature larvæ in various stages between the still feeding, dark-colored specimens (having the alimentary tract distended with food), up through the slow process of preparation for moulting, into the white reproductive form were found and isolated. Isolations of the progeny have been made in the hope of ultimately getting the winged adults of both sexes. It is sincerely hoped that someone will secure the missing links in the life cycle and also determine the factors controlling the development

One day last August (1912), Mr. Snyder remarked that a certain old chestnut log on Plummer's Island, Maryland, looked right for them, and in a few minutes showed me a colony there. Since then I also, have been able to find them, for these larvæ seem to occur in almost any old red-rotten or yellowish-brown decaying oak or chestnut log, lying in the woods along the Potomac, but the original capture by Hubbard and Schwarz, i.e. the occurrence in one colony of numerous larvæ, pupæ, pædogenetic reproductive form and winged adults ready for issuance, does not seem to have been duplicated.

My first suspicion that we were dealing with a really remarkable case, came while looking at one of the vials of material that Mr. Snyder wished identified. This contained three forms of larvæ, but the idea of identity was so improbable, that its expression then would have seemed out of place. In addition to the normal legless larva figured and described by Hubbard, there was a form about one-half its length, similar in head and anal appendages and furnished with long, slender, weak legs which are most remarkable in the chitinized elongate tarsus, bearing two claws (see plate III, fig. 2*b*). The third form was more robust than the normal larva and seemed to be almost free from segmentation; the whole body being soft and formless, the head indistinct, soft and white, except the tips of the mandibles; the tail devoid of the chitinous armature, but terminating in a blunt, transverse carina. It was thought for a time, to be some obscure Dipterous larva, but some resemblance in the contour of the head, and its repeated occurrence with *Micromalthus* larvæ, suggested the possibility of its being a prepupa.

This hypothesis was shattered one afternoon at Plummer's Island, when embryos began issuing alive, but in an oval shape, from the ventral surface, close to the tip of the body of one that had shortly before been isolated in a small vial. I watched two issue, but my field lens was too weak, and more urgent work pressing. Next morning there were seven young legged larvæ crawling about in the vial, while the mother was somewhat shrunken and remained inactive. Lateral and ventral views of this specimen are shown on plate III, figures 1, 1*a*. while figure 2

of the pædogenetic or sexed broods. Perhaps it may be merely a change in temperature due to exposure of the log to sunshine, or food modified by the growth of other organisms or ferments in the rotten wood. Mr. Schwarz recalls that the original capture was in a large log in an open space in a swamp and that the sun shone freely upon the log, while the adult reared by Mr. Snyder was from a log on an open, sunny hillside. It seems imperative that we secure the sexed adults, particularly the egg-laying female and determine if the young larvæ hatching from her eggs are identical with the young legged larvæ here shown.

is one of her young. Thinking she might give birth to more, she was kept in a hollowed, split chip, with some of her young, but she rotted suddenly about a week later, and her young had disappeared in the wood. Two other isolations of this sort yielded respectively, three and five, legged larvæ from the supposed prepupal form, and these legged larvæ crawled into the pores of the wood, fed, lost their legs, and became the normal larva of Hubbard. These larvæ appear to be remarkably slow in their growth, four months (August to December) showing but slight increase in the size of young specimens in captivity. It is impossible to say at present, what substance in the rotting wood furnishes their nutriment. Often the young larva is found following one of the comparatively large pores of the oak wood, leaving the hole behind it plugged with fine particles from the walls of the pore which seems to be only very slightly enlarged, only the tyloses appearing to have been eaten. After the newborn, legged larva had been left a few hours in the crevice of a chip, the alimentary canal could be seen to contain minute quantities of food, of a brown color like the decayed wood.

An examination of Hubbard's alcoholic material discloses several specimens of the reproductive form, some of which contain embryos, while others had given birth to their progeny. A single specimen of the normal tailed and legless form of larva, is remarkable in that the body contents has separated into oblong oval bodies, assuming the appearance of the embryos in the reproductive form. This may be accidental or it may be significant. In another vial are numerous pupæ some of which seem to support the idea of the occurrence of winged adults of both sexes, but as they have been in alcohol for nearly forty years their condition is not the best. No sexual differences are observable among the few winged adults still preserved in the collection. These are thought to be males although the anal structures, seen in cleared slides, are not comparable with the genitalia of any beetle known to me.¹

¹ A specimen was sent to Mr. Fredk. Muir of Honolulu, who, with Dr. David Sharp has just published an extended paper on the male genitalia of beetles (Trans. Ent. Soc., London, 1912, pp. 477-642, plates XLII-LXXVIII) and his reply seems to leave the sex still more uncertain. He writes, ". . . I should have pronounced it a female. There is no definite male structure, and the only way to settle the point definitely is by dissection of the body of a fresh specimen for the testes or ovarian tubes. If this be a male then the only form I can associate it with is *Cyphon* and *Microcara*, a group which Sharp and I have not yet been able to connect with any other form, or even to associate together with any certainty. *Micromalthus* may be somewhat like *Cyphon* (I am here only judging by the ædeagus and not by any other external structure)."

It would be out of place now, to formulate a definite explanation of the unusual life cycle, that is here apparant, and which may be summarized, as far as has been observed, into the five stages: (1) viviparous, larviform, reproductive stage, in cell in wood, giving birth to (2) legged larvæ, which crawl into pores of the wood, feed, and moult becoming, (3) the legless larvæ described and figured by Hubbard, and from which it is believed either the reproductive form (1) or (4) the pupæ of, (5) the winged adults are derived.

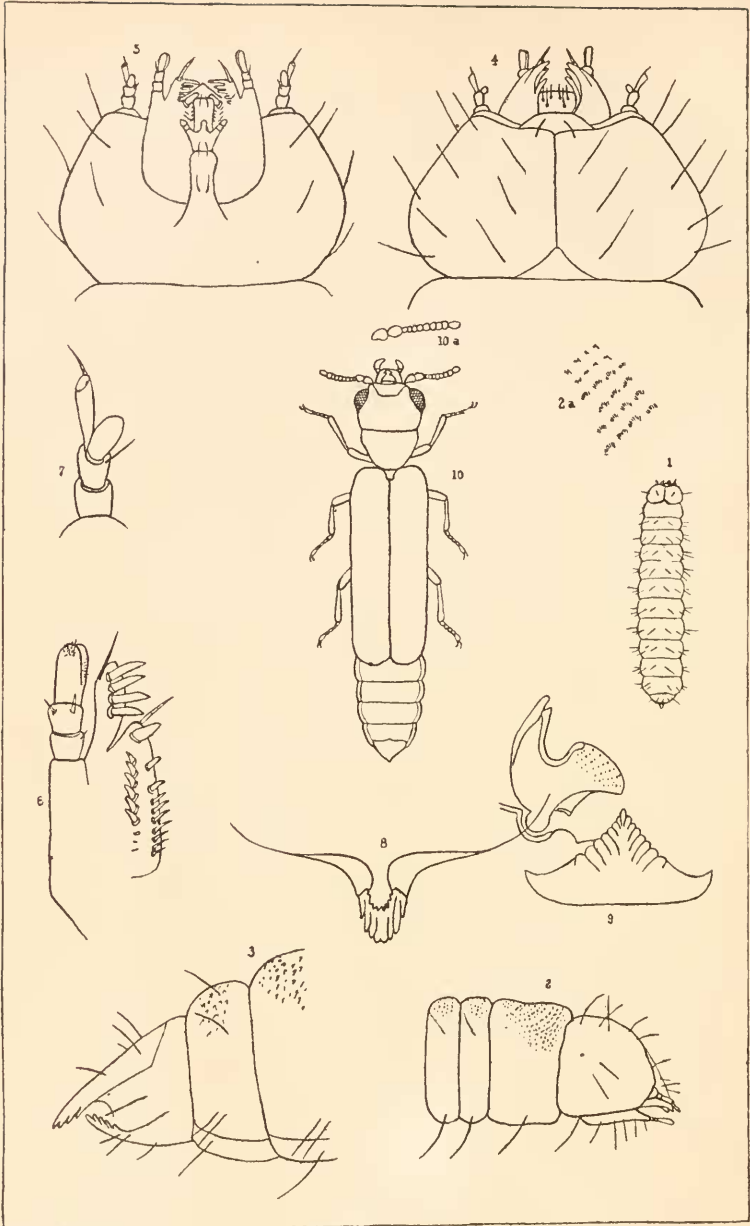
We may have here merely a case of extreme sexual dimorphism, as in *Phengodes*, which lay eggs or the Strepsiptera, which are viviparous, but if so, how is the fertilization of the helpless, reproductive form in the cell of the wood, often some distance underground, accomplished, and how can a new colony become established in a fresh log? There must be a migratory stage, more capable of travel than the crawling first larval stage. Perhaps a winged, egg-laying female will be found, proving the birth of the legged larvæ, from the degraded mother, to be pædogensis, similar to that found in *Miastor*. The well-known agamic, viviparous reproduction of the Aphids may be considered a peculiar case of pædogensis in which the young, being of the form of the adult may acquire wings or other adult characteristics, although they still remain essentially larvæ, the males and egg-laying females being regarded as the only really adult individuals.

The comprehensive article on viviparous and ovo-viviparous reproduction in the Chrysomelid genus *Orina*, by Champion and Chapman¹ brings together the literature on viviparity in beetles. The first mention seems to be Schiodete's account of the finding of well-formed larvæ, in the dilated abdomen of the very remarkable temitophilous Staphylinid, *Corotoca*. It is unfortunate that this paper has been followed by a period of sixty years in which, apparently, no corroborative observations have been made on these beetles which Professor Reinhardt found with certainty in every tree-nest of termites examined in the vicinity of Lagoa Santa, Minas Geraes, Brazil.

For the present the genus should stand alone in our classification, probably representing a distinct family, but it is not improbable, that some of the obscurely treated exotic genera of the Malacodermata, will be found to be allied to it. The possible relationship to the the Nitidulidæ, is suggested by the supplementary third antennal joint of the larva and is somewhat supported by the habitus of the adult.

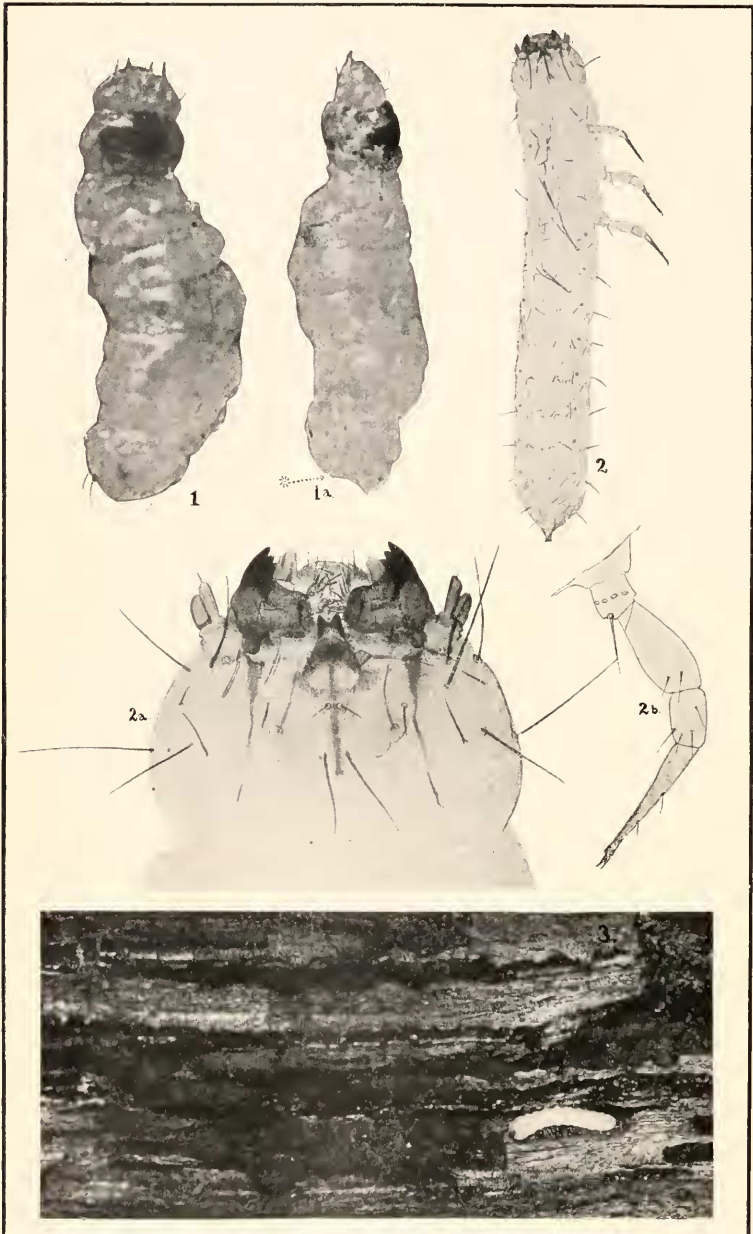
¹ Tr. Ent. Soc., London, 1901, pp. 1-18 plates I and II)

² Vid. Selsk. Skr. 5R. naturo. og math. Afd. 1v, B-1854. author's separate, pp. 14-17, plate 1.



H G Hubbard. del.

Micromalthus debilis Lec. and larva.



MICROMALTHUS DEBILIS LECONTE